Louisiana Response and Action Plan for Asian Soybean Rust[1]

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Introduction

The purpose of this plan is to outline actions for the pre- and post-confirmation of the establishment of Asian soybean rust (*Phakopsora pachyrhizi*) in the United States and Louisiana. Preparing for soybean rust before it is confirmed, is essential to: 1) reduce the response time between initial confirmation and deployment of LSU AgCenter faculty, agricultural consultants and other agricultural professionals to assess the risk of crop loss; and 2) reduce the response time between initial confirmation and employment of mitigation efforts.

This document serves as a guide for state and private stakeholders in Louisiana concerning the detection, response and management of Asian soybean rust.

Asian Soybean Rust Background

Asian soybean rust is an aggressive fungal disease that, under optimal environmental conditions, can reduce soybean yield by as much as 80 percent. It is a potentially damaging disease because the severity can double every 2 to 9 days depending on environmental conditions. It is expected to quickly become endemic to coastal regions in southern Texas and parts of Florida (Pivonia and Yang, 2004) and could cost United States soybean producers $240 million to $2.0 billion annually (Livingston, et al., 2004). A less aggressive species of soybean rust, *Phakopsora meibomiae*, also occurs throughout the world but is not considered yield limiting to soybean in the United States.

After Asian soybean rust was first reported in Japan in 1902, the pathogen moved through Asia, Australia, and Africa before it was discovered in South America in 2000. Asian soybean rust has been moving northward through South America, and it now occurs as far north as five degrees North latitude in Columbia.

The overwintering source(s) of primary inoculum for soybean rust in the United States is not yet known, although at least 20 possible host species (including kudzu) are known to exist in the southern United States. Current research suggests the pathogen will overwinter in certain areas surrounding the Gulf of Mexico and in the Caribbean. Rust spores must be introduced into Louisiana, be deposited on a suitable host, and be exposed to sufficient free moisture and moderate temperatures to initiate infection before yield loss will occur.

The most severe epidemics of Asian soybean rust occur when soybean leaves are infected early in the growing season, however leaves are susceptible at all stages of plant growth. Soybean rust pustules have been recorded on soybean as early as the V1 stage of development and can reproduce on cotyledons, stems and pods.

Epidemics of soybean rust are greatly influenced by environmental conditions. Weather conditions during spore dispersal, deposition and germination greatly influence the success rate of lesion development as well as the time it takes for disease severity to double (i.e., from 2 to 4% severity or 20% to 40% severity). Germination of urediniospores and subsequent host penetration and lesion development require a minimum of 6 to 7 hours of continual wetness with an optimum infection rate occurring if dew periods are $\geq$ 12 hours in duration with temperatures between 18 to 26.5 C (64 to 80F) during the wetness period (Melching et al., 1989). Spores can remain viable in the absence of moisture for durations of no more than 8 days (Kitani and Inoue, 1960; Melching et al., 1989). However, Paltil et al., 1977, reported that soybean rust spores could survive 50 days in the shade. Spore viability is negatively influenced by ultraviolet light. Exposure to sunlight reduces viability of spores compared to spores exposed to cloudy conditions (Melching et al., 1989).

Additional Asian soybean rust identification information is listed in Appendix 1.

Information on the Section 18, Emergency Quarantine Exemption for use of fungicides to prevent and treat Asian soybean rust can be found in Appendix 2.

Training – Pre-Confirmation of Soybean Rust

First Detectors

Extension Agricultural Agents, LSU AgCenter station faculty, LDAF Agricultural Inspectors and Agricultural Consultants will be trained as First Detectors of Asian soybean rust, in the Fall 2004/Spring 2005. First detectors comprise the eyes and ears of the monitoring programs because they monitor the growth and development of Louisiana's soybean crop on a daily basis. First Detectors will be trained to accurately identify all foliar soybean diseases that produce symptoms that may be confused with Asian soybean rust. Training will be provided by LSU AgCenter faculty.

Triage Personnel

LSU AgCenter Diagnosticians have advanced training in diagnosing symptoms of diseases with characteristics similar to Asian soybean rust. Triage Personnel will act as the first screen of potential rust samples and if Asian soybean rust is suspected, confirmation will be sought from USDA-APHIS-PPQ plant pathologists in Beltsville, MD. Contact information for Triage Personnel is listed in Appendix 3.

Commonly Used Terms

First Detectors –Extension Agricultural Agents, LDAF Agricultural Inspectors and Agricultural Consultants.

Triage Personnel – Triage Personnel are Louisiana State University AgCenter Diagnosticians who will act as the first screen of potential rust samples. They have advanced training in plant disease diagnostics.

Suspect Sample – A plant sample that is awaiting positive identification.

Confirmation – A positive identification of a plant sample as Asian soybean rust (*Phakopsora pachyrhizi)*.

Confirmation Process

USDA-APHIS-PPQ has regulatory authority over threatening, non-native organisms. Because rust has been identified as a Select Agent (42 CFR 73) by the United States Department of Homeland Security, particular attention has been focused on early detection and response activities.

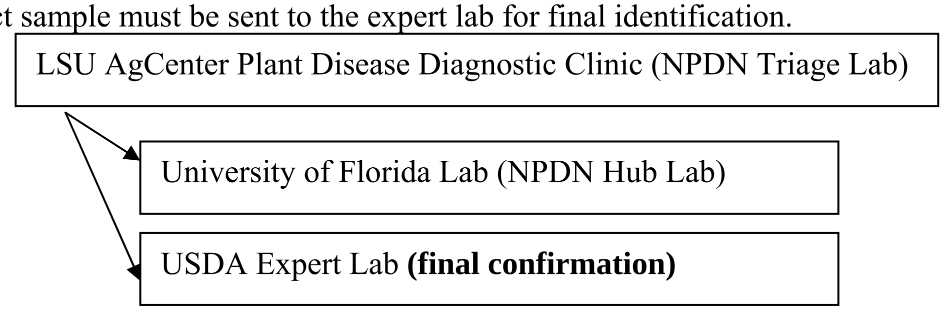
The communication script, to be implemented when the Louisiana State University AgCenter Plant Disease Clinic believes that a positive identification of rust has been made in Louisiana can be found in Appendix 4.

National Plant Diagnostic Network

The mission of the National Plant Diagnostic Network is to enhance national agricultural security by quickly detecting introduced pests and pathogens. This is achieved by creating a functional nationwide network of public agricultural institutions with a cohesive, distributed system to quickly detect deliberately introduced, high consequence, biological pests and pathogens into our agricultural and natural ecosystems by providing means for quick and accurate identifications and establishing protocols for immediate reporting to appropriate responders and decision makers.

The network provides training and continuing education opportunities to diagnosticians to maintain highly skilled state lab personnel. It allows land grant university diagnosticians and faculty, state regulatory personnel, and first detectors to efficiently communicate information, images, and methods of detection throughout the system in a timely manner. Lead universities have been selected and designated as Regional Centers to represent 5 regions across the country. LSU AgCenter is a member of the Southern Pest Diagnostic Network, with the lead lab located at the University of Florida.

In 2004, Louisiana participated in a 'soybean rust scenario exercise' – a trial run of a communication plan including Louisiana's designated NPDN lab at the LSU AgCenter. The focus of the scenario exercise was to conduct a trial run of a communication plan, including the NPDN expert lab in Florida, USDA lab in Beltsville, Maryland, and state of Louisiana and federal plant health regulatory authorities. The communication plan covers all steps of the process from the time that a suspect sample is received by the LSU AgCenter lab until leading federal officials confirm it. The communication script used in the scenario will be implemented when the LSU AgCenter determines that a suspect sample must be sent to the expert lab for final identification.



NOTE: The presence of soybean rust in Louisiana will not be considered confirmed by state or federal officials until both the expert lab in Florida and the USDA lab in Beltsville, Maryland, positively identify the sample as Asian Soybean Rust (*Phakopsora pachyrhizi)*. **The Section 18 for fungicides will not be implemented until confirmation in the continental United States.**

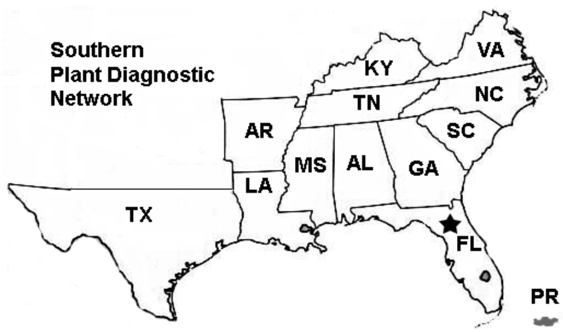


Figure 1. *If LSU AgCenter believes the sample is likely to be rust, LSU AgCenter is responsible for submitting the sample to the SPDN lab in Florida and/or USDA expert lab in Beltsville, MD.*

Development of an LSU AgCenter / First Detector Alliance

The purpose of this alliance would be to enable a cost-effective, widespread network of trained observers to monitor (survey) soybean fields in every parish for the presence of soybean rust. It would maximize the state's ability to quickly detect the pathogen and initiate a response and recovery plan.

Establishment of a two-way communication system would be helpful. Members of the network should be in constant contact with LSU AgCenter soybean pathologists via cellular telephone and email. First Detectors could participate in periodic conference calls to discuss rust issues and record, including GPS coordinates, confirmed locations of soybean rust. This information could be used to track the movement and severity of the disease throughout the state. This two-way communication system would be critical in the early stages of the epidemic.

Submission of Plant Samples

To keep from overburdening the LSU AgCenter Plant Disease Diagnostic Clinic with avoidable suspect samples, **First Detectors must contact Triage Personnel before submitting samples to the lab**. Triage personnel are trained to recognize symptoms from pathogens with similar characteristics as rust. Plant sampling instructions are shown in Appendix 5. Figure 2 depicts the flow of the identification and confirmation process.

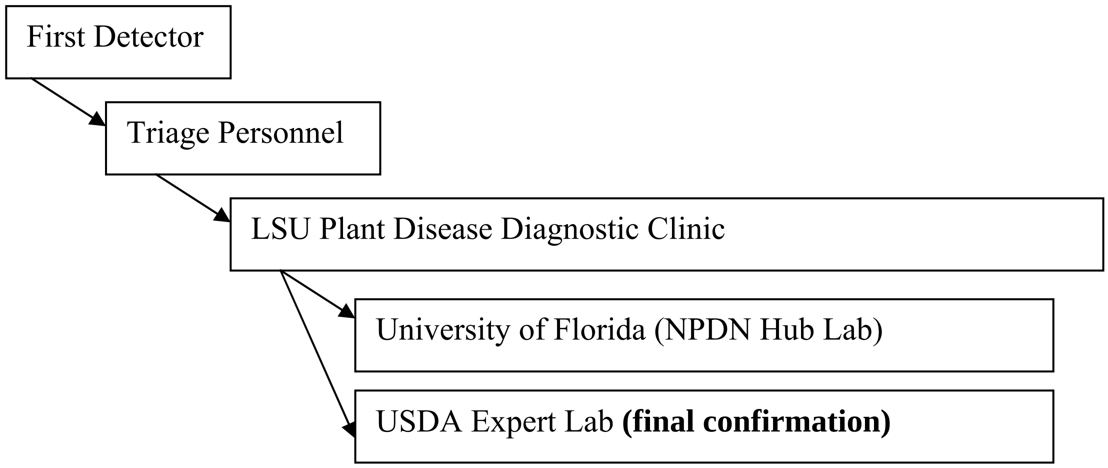


Figure 2. *Identification & Confirmation Process: First Detectors must contact Triage Personnel before a suspect rust sample may be submitted to the LSU AgCenter lab for diagnosis*

Communication Plan

Pre-confirmation

The purpose of a pre-confirmation communication plan is to 1) ensure that all stakeholders are prepared for an epidemic of soybean rust; 2) identify and commit resources to carryout an effective post-confirmation communication program; 3) increase grower awareness in order to reduce the impact of a rust epidemic; and 4) assemble relevant information on identification and management of soybean rust that, when transferred, will enable the producer to minimize the impact of soybean rust.

Action items in this category can be initiated immediately and should continue until soybean rust is confirmed in the United States. Items to be produced may include:

- √ Talking points for LSU AgCenter administration, Commissioner of Agriculture, Louisiana Farm Bureau, and leaders of Louisiana Soybean Promotion Board.
- √ Press releases – To be released when rust is confirmed in the state.
- √ Develop a list of Frequently Asked Questions and Answers Appendix 6
- √ Develop a series of fact sheets to be distributed to media.
    - Include the National Pest Alert system for Soybean Rust
    - History of Asian soybean rust as it progressed from Asia through South America and into the United States

  - Soybean producer action recommendations – expected yield loss if left untreated
  - List of approved fungicides and application rates / timing of application

√ Develop website links for Louisiana information developed by the Department of Plant Pathology and Crop Physiology, e.g. www.soybeanrust.info is a centralized source of information on soybean rust.

  - Include list of frequently asked questions & answers
  - Include rust background material
  - Include confirmed location / severity of rust
  - Include farmer action recommendations
  - Include list of approved fungicides and application recommendations (to be provided by chemical companies)
  - Include links to credible web sites for additional information such as www.planthealth.info and www.aphis.usda.gov/ppq/rust

Post-confirmation

The purpose of the post-confirmation communication plan is to minimize the impact of a rust epidemic. This will be accomplished by 1) the rapid distribution of print material containing information needed to manage the disease and 2) effective utilization of radio, TV and print media to educate the soybean producer on the need to scout and treat for soybean rust.

Two post-confirmation communications plans could be developed for when 1) rust is first confirmed in the United States and 2) soybean rust is first discovered in Louisiana.

√ Develop and distribute list of key persons whom should be informed prior to release to media (Appendix 7)

√ Prewritten press releases – develop two to three with fill-in-the-blanks for dates and location of confirmation, etc. that can be quickly released to the media. They should include key messages, such as:

  - LSU AgCenter, LDAF, USDA, industry and stakeholders have been preparing for the arrival since 2003.
  - This is a serious threat to our soybean crop, but thanks to our preparation in recent years, there are a number of treatment options available for soybean producers.
  - LSU AgCenter, USDA and LDAF are looking into how the disease reached Louisiana, but we are not aware of any evidence it was done intentionally.
  - Direct interested parties to key web sites for information: 1) www.soybeanrust.info; 2) www.planthealth.info; and 3) www.aphis.usda.gov/Ipa/Issues/sbr/sbr.html.

Activation of the Soybean Rust Action Plan

Confirmation outside Louisiana

Notification and Mobilization

Execute post-confirmation communication plan

The first hour

- √ Notify all key LSU AgCenter, APHIS and LDAF contacts.
- √ Notify all key external stakeholders (Appendix 7)
- √ Send out public statement from LSU AgCenter.

The first day

- √ Organize and conduct press briefing to inform Louisiana producers of preparations that have been made in anticipation of arrival of rust, including approved Section 18 fungicides.
- √ Emphasize that the disease was found elsewhere and not in Louisiana.

Confirmation within Louisiana

Notification and Mobilization

Execute post-confirmation communication plan

The first hour

- √ Notify all key LSU AgCenter, LDAF and APHIS contacts.
- √ Notify all key stakeholders (Appendix 7)
- √ Send out public statement from LSU AgCenter.
- √ Announce time and location for press briefing
- √ Organize press briefing at appropriate venue.

Activation

Continue daily communication among state authorities, LSU AgCenter and stakeholders

Develop a mechanism or plan, monitor (survey) and keep producers and media informed of progression /severity of rust once it enters Louisiana.

- Daily/weekly updates with radio, print media
- Press releases
- www.soybeanrust.info and possibly www.planthealth.info

Examples of Research Priorities

Develop an accurate early-detection tool to be used in the field by soybean producers and crop advisors.

1. Conduct proof-of-performance trials in Louisiana. Current fungicide efficacy trials for soybean rust are being conducted outside the United States. Researchers at LSU AgCenter should conduct fungicide trials under Louisiana growing conditions to: 1) verify performance at recommended and possibly alternate use rates; 2) verify performance at each recommended time of application for each labeled fungicide/tank mix; 3) determine efficacy on other foliar diseases and 4) determine compatibility and performance with commonly used insecticides.
2. Develop an accurate method to predict and monitor migration of rust spores from overwintering sites into key soybean producing areas.
3. Determine yield losses and develop a risk/benefit model.
4. Monitor the population of *Phakopsora pachyrhizi* in the U.S. for genetic shifts. Monitor performance against labeled fungicides. Compare the population in the U.S. to those in Brazil, China, Taiwan, etc.
5. Assess varietal reactions in statewide trials.
6. Monitor populations of the pathogen for resistance to commonly used fungicides.
7. Assess alternative hosts for overwintering potential.

Literature Cited

Kitani, K., and Y. Inoue. 1960. Studies on the soybean rust and its control measure. Part I. Studies on the soybean rust. Bull. Shik. Agric. Exp. Stn. (Zentsuji, Japan) 5:319-342.

Livingston M., R. Hohansson, S. Daberkow, M. Roberts, M. Ash, and V. Breneman. 2004. Economic and Policy Implications of Wind-borne Entry of Asian soybean rust into the United States. USDA Economic Research Service. OCS-04D-02.

Melching, J.S., W.M. Dowler, D.L. Koogle, and M.H. Royer. 1989. Effects of duration, frequency, and temperature of leaf wetness periods on soybean rust. Plant Disease. 73:117-122.

Patil, V.S., R.V. Wuike, C.S. Thakare, and B.B. Chirame. 1977. Viability of uredospores of *Phakopsora pachyrhizi* Syd. at different storage conditions. J. Maharashtra Agric. Univ. 22(2):260-261.

Pivonia, S., and X. B. Yang. 2004. Assessment of the Potential Year-Round Establishment of Soybean Rust Throughout the World. Plant Disease. 88:523-529.

APPENDIX

One

Identification of Asian Soybean Rust

(The following material was reprinted in part from the Minnesota Soybean Rust Response Plan.)

Symptoms of soybean rust appear identical regardless if they are caused by *Phakopsora pachyrhizi* or *Phakopsora meibomiae*. Host plants infected with soybean rust first exhibit small lesions that gradually increase in size and turn from gray to tan or brown. They become polygonally shaped restricted by leaf veins, and may eventually reach 2 to 3 square millimeters.

Infection begins on the lower leaves of plants and appears as chlorotic or mosaic-like areas with uredinia observed usually at or after the plant flowering stage. Lesions may appear on most above-ground plant parts, but they are most common on the underside of the leaves. As the plant matures and sets pods, infection progresses rapidly under the right environmental conditions (i.e., moisture, high humidity and temperature) to cause high rates of infection in the middle and upper leaves of the plant. Clouds of spores have been observed within and above canopies of highly infected plant stands.

Plants show two different lesion reactions to infection by soybean rust. Tan lesions consist of small uredinia surrounded by slightly discolored necrotic areas on leaf surfaces. Early stages show an ostiole, or small hole, where urediniospores emerge. As uredinia become larger, they release masses of tan colored urediniospores that appear as light brown or white raised areas. Uredinial pustules become more numerous with advancing infection and often will coalesce forming larger pustules that break open releasing masses of urediniospores.

The other type of lesion that occurs with soybean rust infection is the reddish-brown lesion. These lesions have larger areas of necrosis that are reddish brown surrounding a limited number of uredinia. A few urediniospores are usually visible on the surface.

Early symptoms of soybean rust are easily confused with bacterial pustule (caused by *Xanthomonas campestris pv. phaseoli* (Smith) Dye), or bacterial blight (caused by *Psuedomonas glycinea* Coerper), and brown spot (caused by the fungus S*eptoria glycines).* The diseases also occur often on the underside of soybean leaves causing a raised light brown blister within a lesion. These leaf lesions vary from small specks to large irregular brown areas that form when small lesions coalesce. A hand lens or dissecting microscope are usually used to distinguish these disease symptoms from ASBR, but the early stages of disease are difficult to distinguish if no spores, conidia, or bacteria are evident.

Recovery from Asian Soybean Rust

The occurrence of Asian soybean rust will have a significant impact on the production of soybeans in the United States. The impact on more northern soybean growing areas is expected to be less severe than effects in the southern United States as the disease must re-infest the crop from inoculum coming from more southerly climates and regions. Growers can expect an increase in production costs related to fungicides and their application to protect the crop.

In areas with a high likelihood of infection, it is suggested that growers consider removing non-cultivated soybean rust host material from field borders. The removal of this material will decrease the availability of sites for inoculum buildup.

The best long-term strategy for minimizing the effects of soybean rust in the United States is in the development of resistant/tolerant varieties. There are thousands of plant lines of soybean in germplasm repositories, and screening for soybean resistance has been on-going for several years in other countries and the United States in the containment facilities at the ARS Foreign Disease-Weed Science Research Unit in Ft. Dietrick, Maryland. However, the availability of cultivars with good resistance and other characters desired in soybean for commercial production is still five to seven years away.

Fungicides have been shown to be effective in controlling soybean rust in Zimbabwe, South Africa and Brazil. An effort is underway to obtain a State Exemption (Section 18) for seven fungicides. Several chemical companies that already have fungicides registered for soybeans have relabeled their products to include control of *Phakopsora sp.* on soybeans and other leguminous crops.

Currently there are only two fungicides (Quadris=azoxystrobin and Bravo=chlorothalonil) registered for ASBR control in the United States. The scientific community and industry agree that the development and use of resistant/tolerant varieties is the long-range goal to overcome production losses associated with ASBR.

APPENDIX

TWO

Fungicides Submitted for Approval Under the Section 18, Emergency Quarantine Exemption

NOTE. An application for Section 18 approval has been submitted by LDAF on or about April 4, 2004. The Section 18 application package is being reviewed by EPA.

- The application requested up to two applications of an approved fungicide on eighty percent of the acres planted to soybean in Louisiana.
- When approved, the Section 18 Emergency Quarantine Exemption to apply fungicides as a protective or curative treatment will **NOT** be enacted until Asian soybean rust (*Phakopsora pachyrhizi*) is confirmed in the continental United States.

Products are listed in order of greatest potential for availability and preference for use.

Common Chemical Name (Active Ingredient): **propiconazole**

Trade Names(s) And EPA Reg. No.: Tilt®, EPA Reg. Number 100-617
Formulation: 3.6EC
% Active Ingredient: 41.8% (3.6 lb/gal)
Manufacturer: Syngenta Crop Protection, Inc.; Greensboro, NC 27409

Common Chemical Name (Active Ingredient): **propiconazole**

Trade Names(s) And EPA Reg. No.: PropiMax™ EC, EPA Reg. Number 62719-346
Formulation: 3.6EC
% Active Ingredient: 41.8% (3.6 lb/gal)
Manufacturer: Dow Agrosciences, LLC; Indianapolis, IN 46268

Common Chemical Name (Active Ingredient): **propiconazole**

Trade Names(s) And EPA Reg. No.: Bumper®, EPA Reg. Number 66222-42
Formulation: 41.8EC
% Active Ingredient: 41.8% ai by weight (3.6 lb/gal)
Manufacturer: Makhteshim-Agan; New York, NY 10176

Common Chemical Name (Active Ingredient): **tebuconazole**

Trade Names(s) And EPA Reg. No.: Folicur®, EPA Reg. Number 3125-394

Formulation: 3.6F
% Active Ingredient: 38.7% (3.6 lb/gal)
Manufacturer: Bayer Corporation; Kansas City, MO 64120-0013

Common Chemical Name (Active Ingredient): **myclobutanil**

Trade Names(s) And EPA Reg. No.: Laredo™ EC, EPA Reg. Number 62719-412
Formulation: 25EC
% Active Ingredient: 25% (2 lb/gal)
Manufacturer: Dow AgroSciences LLC; Indianapolis, IN 46268

Common Chemical Name (Active Ingredient): **myclobutanil**

Trade Names(s) And EPA Reg. No.: Laredo™ EW, EPA Reg. Number 62719-493
Formulation: 25EW
% Active Ingredient: 25% (2 lb/gal)
Manufacturer: Dow AgroSciences LLC; Indianapolis, IN 46268

Common Chemical Name (Active Ingredient): **propiconazole + trifloxystrobin**

Trade Names(s) And EPA Reg. No.: Stratego®, EPA Reg. Number 264-779
Formulation: 2.08F
% Active Ingredient: 11.4% propiconazole (1.04 lb/gal), 11.4% trifloxystrobin (1.04 lb/gal)
Manufacturer: Bayer Corporation; Kansas City, MO 64120-0013

Common Chemical Name (Active Ingredient): **tetraconazole**

Trade Names(s) And EPA Reg. No.: Domark™, EPA File Symbol 60063-RE
Formulation: 125SL
% Active Ingredient: 11.6% (125g/l ai – 1 lb ai/gal)
Manufacturer: Sipcam Agro USA, Inc.; Roswell, GA 30076

Common Chemical Name (Active Ingredient): **pyraclostrobin + boscalid**

Trade Names(s) And EPA Reg. No.: Pristine®, EPA Reg. Number 7969-199
Formulation: 38% WDG
% Active Ingredient: 25.2% boscalid, 12.8% pyraclostrobin (38% total ai)
Manufacturer: BASF Corporation; Research Triangle Park, NC, 27709

Common Chemical Name (Active Ingredient): **pyraclostrobin**

Trade Names(s) And EPA Reg. No.: Headline®, EPA Reg. Number 7969-186
Formulation: 2.09EC
% Active Ingredient: 23.6% (2.09 lb ai/gal)
Manufacturer: BASF Corporation; Research Triangle Park, NC, 27709

APPENDIX

THREE

Triage Personnel Contact Information

Dr. H. Kenneth Whitam, Soybean Pathologist
Office: 225.578.4562

Dr. Raymond W. Schneider, Soybean Pathologist
Office: 225.578.4880

Dr. Clayton A. Hollier, Plant Pathologist
Office: 225.578.4487
Cell: 225.281.9365

Dr. G. Boyd Padgett, Plant Pathologist
Office: 318.435.2157
Cell: 318.290.0060

Dr. David Y. Lanclos, Soybean Agronomist
Office: 318.473.6530
Cell: 318.308.5386

Dr. Jerry Berggren, Department Head and Soybean Pathologist
Office: 225.578.1464

APPENDIX

FOUR

Pre-Confirmation Communication Script

Updated 6-1-04

<u>APHIS Pest of Concern Scenario – General SOP- Draft</u>

1 Grower, Pest Advisor or other Sample Submitting Entity brings sample and submits diagnosis request to State Department of Agriculture and Forestry (LDAF), regional APHIS, or university faculty (LSU AgCenter).

2a LDAF, regional APHIS, or university staff delivers sample to National Plant Diagnostic Network Triage Lab (Plant Disease Diagnostic Clinic, Department of Plant Pathology and Crop Physiology).

2b Triage Lab staff acknowledges receipt and enters the sample into the system assigning a unique lab ID number to the sample.

2c Triage Lab staff examines sample.

2d Triage Lab staff contacts originating state's SPRO, Expert Lab and APHIS Confirming Diagnosis Designate to inform them that Triage Lab has received a suspect sample and is requesting confirming diagnosis. The APHIS Confirming Diagnosis Designate may be an APHIS National Diagnosis Service staff member or an NPDN expert lab diagnostician and is to be assigned by APHIS NIS staff.

2e Triage Lab staff, Expert Lab staff and/or APHIS Confirming Diagnosis Designate conduct live web-based distance diagnosis examination of sample and microscope mounts, if Triage Lab has this distance diagnosis capability. Or the diagnostician can take a digital image and email to the other two diagnosticians if web cam is not available.

2f Triage lab staff divides sample and sends it to the APHIS Confirming Diagnosis Designate for diagnosis, unless the Designate indicates to the Triage Lab to send the sample to the expert lab instead. Sample is double bagged in zippable bags and entirely sealed in a box with tape. Sample submission form 391 or local sample submission form is included in the box. The diagnostician's business card should also be included in with the sample. The Fed Ex box should be marked as plant samples for diagnosis. Late afternoon and evening Fed Ex pickup locations can be found at www.fedex.com if needed.

2g Triage Lab informs originating state SPRO, APHIS Diagnosis Designate or Expert Lab of sample shipment time and delivery method, including tracking number and sample number.

3a Originating State SPRO contacts originating State APHIS SPHD staff to inform of suspect sample in the system.
3b Originating State SPRO prepares for response in collaboration with originating APHIS SPHD, but does not act with response until confirmation of diagnosis is received.
3c Originating State SPRO and APHIS SPHD may choose to communicate with regulatory officers in neighboring states in planning and/ or activating response strategy.
3d Triage Lab staff contacts its own Campus Safety Officer to inform of suspect sample in the system.

4a If an Expert Lab receives a sample, Expert Lab Staff acknowledges sample receipt to Triage Lab.
4b Expert Lab staff examines sample.
4c Expert Lab staff contacts Local and/or Outside expert, for additional input, but does not disclose state of origin.
4d Local and/or Outside Expert examines sample.
4e Local and/or Outside Expert make preliminary diagnosis in collaboration with Expert Lab staff.

5a Local and/or Outside Expert contacts Expert Lab Diagnostician with conclusions/results.
5b Expert Lab Diagnostician contacts NPDN Regional Director and APHIS NIS with local expert's preliminary conclusions/results.
5c Expert Lab staff contacts Expert Lab state's State SPRO and APHIS State SPHD to inform them that a suspect sample is housed in Expert Lab until shipment to APHIS Confirming Diagnostician or APHIS Designate or until it is destroyed following diagnosis. The state of origin is not disclosed to Expert Lab's state SPRO / SPHD.
5d Expert Lab staff contacts its own Campus Safety Officer to inform of suspect sample in the system. State of origin is not disclosed.

6a Regional NPDN Director from region of origin of the sample contacts NPDN Program Manager and other Regional NPDN Directors indicating that suspect sample is under diagnosis. State of origin is not disclosed except to Program Manager.
6b Regional NPDN Directors contact diagnosticians in their respective regions at NPDN labs in each state to inform them that a suspect sample is under diagnosis in an unknown location in the nation and to be alert for similar samples that may be appearing in other labs.
6c Regional NPDN Director in region of origin contacts other Diagnostic Labs in the region to say that a suspect sample is under diagnosis. State of origin is not disclosed.

7 If APHIS NIS requests Expert Lab to send sample for confirmation, Expert Lab, in coordination with Local/Outside expert, contacts APHIS Confirming Diagnosis Designate indicating that they are sending the sample to APHIS including shipment date, method, tracking number and sample number.

8 Expert Lab ships to APHIS Confirming Diagnosis Designate, unless Designate specifies that shipment is not necessary.

9a APHIS Confirming Diagnosis Designate acknowledges receipt of sample to Triage Lab and /or Expert Lab. APHIS Confirming Diagnosis Designate also states approximate expected date and time of notification of results.
9b APHIS Confirming Diagnosis Designate examines sample and makes confirming diagnosis.
9c APHIS Confirming Diagnosis Designate contacts APHIS Administrator or other appropriate APHIS staff with confirming diagnosis results.
9d APHIS Administrator or other APHIS staff contacts Regional and State APHIS SPHD staff in state of origin with confirming diagnosis results
9e State APHIS SPHD staff in state of origin contacts State SPRO staff in state of origin with confirming diagnosis results.
9f State SPRO in state of origin submits record to state, regional and/or NAPIS databases.

10a APHIS Confirming Diagnosis Designate contacts Triage Lab Staff with confirming diagnosis results.
10b Triage Lab Diagnostician contacts Expert Lab Staff, if engaged, with confirming diagnosis results.

11a Triage Lab staff submits record to NPDN databases at state, regional and NAPIS-NPDN databases
11b Triage Lab staff and University Extension coordinate with SPRO and SPHD to contact Sample Submitting Entity with results as approved and designated by APHIS and the SPRO of the state of origin.
11c Triage Lab staff contacts its own Campus Safety Officer w/ positive or negative result and assurance of sample destruction. State of origin is not disclosed. Sample is destroyed by placing all packing material and the sample in an autoclave for at least 20 minutes. During storage, sample and its packing material should be stored in clean, new bags, double sealed, with paper toweling between leaves. Sample should be stored in a secure location with limited access so that it can be proven who had access to the sample and who did not.

12 Triage Lab staff contacts State of Origin SPRO and Regional NPDN Director with positive or negative result.

13 Regional NPDN Director contacts National NPDN Program Leader w/ postitive or negative results.

14 Regional NPDN Director contacts other NPDN Regional Directors w/ positive or negative result. State of origin is not disclosed.

15 National Program Leader contacts Secretary of Agriculture w/ positive or negative result.

16 If engaged, Expert Lab staff contacts SPRO and SPHD for its own state w/ positive or negative result and assurance of sample destruction. State of origin is not disclosed.

17 If engaged, Expert Lab staff contacts its own Campus Safety Officer w/ positive or negative result and assurance of sample destruction. State of origin is not disclosed.

18 Regional NPDN Directors contact Regional NPDN Labs w/positive or negative result. State of origin is not disclosed.

Criteria for evaluation:

- Information flows through the appropriate nodes of pathway
- All essential participants are informed of sample status at the appropriate time
- Feed back loops are complete at each step
- Decision makers and regulators are informed immediately upon confirmation of diagnosis
- Diagnostic time line is as rapid as possible
- Information flow time line is as rapid as possible
- Regional, state and NAPIS data entry is performed in a timely manner.

APPENDIX

FIVE

Plant Sample Collection Instructions

1. Once the triage person determines the sample should be submitted to the LSU Plant Disease Clinic, care must be taken to avoid contaminating other fields after sampling the suspicious plants. Inadvertent contamination on hands, clothing, vehicles and field equipment could result in unintentional spread of the soybean rust pathogen.
2. Select several leaves as specimens. The leaves should have recent infections. Completely yellowed or browned leaves are difficult to diagnose. Place leaves in zippable plastic bags (double bag), squeeze out the air, and hand-deliver to one of the people named in Appendix
3. Be sure to note precise location (with GPS, if available) so that the site can be sampled again, date of collection, stage of plant growth, and, if possible, variety.

APPENDIX

SIX

Frequently Asked Questions about Soybean Rust

How likely are we to face an outbreak of soybean rust in 2005?
The arrival of *Phakopsora pachyrhizi*, the fungus that causes soybean rust, becomes more likely each year as reports of its occurrence in northern Brazil and southern Columbia become more frequent. Asian Soybean Rust has been moving northward through South America and now occurs as far north as five degrees North latitude in Columbia.

The entrance point is expected to be somewhere in the gulf or east coast states based on historical weather patterns. Prevailing winds would bring spores primarily from northern coastal regions of South America, Central America and the Caribbean.

Epidemiologists working on the natural spread of rust think that entry via hurricane activity from South or Central America or the Caribbean is likely. Monitoring the northern movement of the pathogen is critical as it progresses towards the U.S. It could come quickly by tropical storms or more slowly through the Central American land bridge to a southern U.S. state.

Opinion varies on the time required for soybean rust to reach its potential range throughout the U.S. It could take one season or several years, although each year may differ as the pathogen will not over-season in temperate areas unless it is kept inside on soybean plants in the greenhouse.

What areas of the U.S. are most at-risk to yield losses from soybean rust?
All soybean-growing areas of the U.S. are at risk with the most favorable weather conditions, based on 30 year averages, in the Mississippi delta region and the Midwest. In general, southern growing areas are at greater risk than northern areas because of the longer growing season, the warm, humid climate that is favorable for rust development, and the presence of other hosts such as kudzu.

Risk analyses indicate that *P. pachyrhizi* could cause yield losses of greater than 10% in any U.S. soybean-growing region; while in southeastern coastal states losses up to 50% are possible. Of course, this is all dependent on weather conditions during the growing season and the actual point where the pathogen enters the country.

Will soybean rust overwinter in Louisiana’s climate?
Areas that are likely to support year-round occurrence of *P. pachyrhizi* are the southern parts of the very southernmost United States and further south of the U.S. where freezing temperatures are rare. The presence of kudzu and several other hosts in those southernmost areas would create conditions for the rust fungus to become established.

Are imports of soybean meal, planting seed or whole soybeans likely to introduce rust to the U.S.?
No, the fungus is not seed borne. There is a very slight chance that spores could be associated with debris in seed. Research is ongoing to determine the influence of storage time and temperature on the survivability of rust spores. For meal there is virtually no chance of contamination since both the meal and the foreign material it contained are heat-treated, eliminating the risk that rust spores could survive. The American Soybean Association (ASA) has worked closely with the U.S. Animal and Plant Health Inspection Service (APHIS) to reduce the risk of accidental introduction of rust.

Are fungicides effective against soybean rust?
Yes, there are effective fungicides in use in other countries. If soybean rust arrives in the U.S., fungicides will be the major tool to protect yield.

In addition to efficacy, there are other important questions being addressed in current USDA-ARS fungicide trials in Africa and South America: application methods, the effect of fungicides on the crop, timing, minimum number of applications, and effective rates for each compound, as well as the economics of using fungicides on soybeans. The rust fungus is a highly variable pathogen, and resistance management may be an issue.

Will there be enough fungicide available to treat all my acres?
It depends when the rust pathogen arrives and on the extent of the outbreak. Section 18 Emergency Quarantine Exemption requests have already been drafted in order to expand the number of fungicides available if needed. Each season without the introduction of rust allows for additional fungicides to be evaluated, registered and manufactured, and provides time for the development of resistant soybean varieties. Once approved, the Section 18 Emergency Quarantine Exemption will be activated when *Phakopsora pachyrhizi* is confirmed in the continental United States.

When will varieties be available that are genetically resistant to soybean rust?
Best estimates say at least 4 to 6 years. The good news is that much groundwork has been done. Partial resistance or tolerance is likely to be the most effective resistance strategy in which fewer lesions with a reduced number of spores develop. Planting cultivars with resistance to rust pathogens has been very successful in managing rust in wheat and corn and is expected to be a successful approach with soybean rust.

How are my soybean checkoff dollars being used to help find solutions to this problem?
State and national soybean associations funded by soybean checkoff dollars have been the leaders in preparing for soybean rust. They have funded research on rust movement and occurrence, and research on soybean resistance and the screening of commercial soybean varieties. They have been at the forefront of preventing accidental introduction of rust into the U.S., promoting federal funding for research, and encouraging the EPA and chemical companies to work on the availability of fungicides. Soybean checkoff dollars have funded much of the information on rust available to soybean growers.

What is being done to monitor the movement of soybean rust in South America?
Air traps have been set up and molecular identification techniques are being used to distinguish the aggressive rust species from the mild one. At this time, the aggressive rust species has just recently been confirmed north of the equator in Columbia. In the U.S., the Florida Department of Agriculture has had a detection and surveillance program in place since February 2003 for soybean and kudzu. This program is now expanding into other southern states.

Is there anything I can do now to prepare for soybean rust?
Continue to stay informed as you are now.

If you suspect soybean rust is present in your fields this season, contact your local county extension office, a certified crop advisor, or your state university plant diagnostic lab. Any of these resource people will be able to determine if it could be rust or another soybean foliar disease. If rust is suspected, the samples will be shipped for a second level of testing by the USDA-APHIS National Mycologist. This is to determine the type of rust, mild or aggressive.

What does the disease look like?

The most common symptom of *Phakopsora pachyrhizi* is tan to dark brown or reddish brown lesions. The disease begins with small, water-soaked lesions, which gradually increase in size, turning from gray to tan or brown. They assume a polygonal shape restricted by leaf veins and usually coalesce to form larger lesions. Lesions can appear on petioles, pods, and stems but are most abundant on leaves, particularly on the underside of the leaf.

As the plant matures and sets pods, the symptoms spread rapidly to the middle and upper parts of the plant. Lesions are found on petioles, pods, and stems but are most abundant on leaves.

Especially at the early stages, it is easy to confuse the symptoms of soybean rust with symptoms of three other soybean leaf diseases: **brown spot** caused by the fungus, *Septoria gycines*, bacterial **pustule**, caused by *Xanthomonas axonopodis pv. glycine*s, and **bacterial blight** (also called **angular leaf spot**), caused by *Pseudomonas savastanoi pv. glycinea*.

How does this disease affect soybean?

Asian soybean rust is an aggressive disease that destroys photosynthetic tissue, causing premature defoliation, early maturation, and lower yields. The most severe epidemics occur when soybean leaves are infected early in the growing season, however leaves are susceptible at all stages of plant growth.

Does it affect any other crops grown in the southern region?

Some common leguminous crop plants and weeds are also hosts, including yellow sweet clover (*Melilotus officinalis*), vetch (*Vicia dasycarpa*), medic (*Medicago arborea*), green and kidney bean (*Phaseolus vulgaris*), lima and butter bean (*Phaseolus lunatus*) and kudzu (*Pueraria lobata).* Sugarcane, cotton, rice corn and other grain crops are not hosts to Asian soybean rust.

How far and how fast can we expect this disease to spread?

Soybean rust dispersal is highly dependent on environmental conditions. Once the pathogen is present, abundant spore production occurs during wet leaf periods of at least 8 hours (including extended dew periods) and moderate temperatures of 60 to 80°F. The spread of the disease within a field can occur quickly. Long-distance dispersal is dependent on wind patterns and weather conditions and is the subject of current research.

When should I start scouting for soybean rust?

Asian soybean rust differs from other foliar diseases in that plants are susceptible in their vegetative stages of growth (V-stages). Therefore scouting should commence early in the season particularly following prolonged rainy periods. Plants are more susceptible after flowering and scouting efforts should be intensified at that time.

When should we start to spray the disease once it is found in our area?

Current research suggests that the first application should be applied at the initiation of flowering (R1). The second application, if needed, should be applied 20 days later.

How many times do we need to spray in a season?

Based on current research, soybean producers will likely need to apply two or three applications of a fungicide to obtain optimal results.

In Brazil during the 2003-2004 season, it was estimated that 95% of the acreage was treated with 1 or 2 sprays. Short-season varieties only required one spray, while long-season varieties needed 2-3 applications.

How long will it take for the rust to move from the south to the north?

Opinion varies on the time it will require for Asian soybean rust to reach its potential range after the initial introduction into the United States. It could take one season or several years.

Once established in the southernmost areas of the U.S., the spread of rust from south to north will be different each year. Movement will depend on the amount of inoculum that overwinters in the south each year and on spring weather conditions.

Is this an act of agro-terrorism?

No, the spread of soybean rust has been a natural event. There is no evidence of intentional introduction by humans.

Could this have been prevented? How?

No. As more land was planted into soybean around the world, the spread of soybean rust eventually came with it.

Will insurance cover the losses caused by soybean rust?

When a producer is insured and follows good farming practices, losses attributed to disease, including Asian soybean rust, are often insurable. Soybean producers should verify their coverage with their insurance provider.

If found in continental US, but not yet in Louisiana, will Louisiana researchers be allowed to bring rust into Louisiana for research? Once confirmed in Louisiana, will researchers be allowed to import rust for research in Louisiana?

These are important questions that both the USDA and LDAF must answer.

APPENDIX

SEVEN

Key Stakeholder Contact Information:

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APPENDIX

EIGHT

USDA-APHIS information on *Phakopsora pachyrhizi*.

The USDA-APHIS information can be found at:

www.aphis.usda.gov/ppq/ep/soybean_rust/UreMelPp502.pdf

Appendix
Nine

Glossary

Agro-terrorism – a systematic use of terror, within agriculture, especially as a means of coercion.

APHIS – Animal and Plant Health Inspection Service.

FAQ – Frequently asked questions.

First Detectors – the “eyes and ears” of a pest monitoring system. The first to likely find a new pest.

Inoculum – a pathogen or its parts used for inoculating to produce disease.

LSU AgCenter – a campus of the Louisiana State University System that serves Louisiana’s citizens by research and extension efforts.

LDAF – Louisiana Department of Agriculture.

NPDN – National Pest Diagnostic Network.

Ostiole – a small pore or cavity from which spores are released.

Overwinter – to survive the winter.

Polygonal – having many angles.

Triage – the process of determining priority.

SPDN – Southern Pest Diagnostic Network.

SPHD – State Plant Health Director

SPRO – State Plant Regulatory Officer

Uredinia – a fruiting body of a rust pathogen.

Urediniospores- spores produced in a uredinium. In the case of Asian soybean rust these are the spores that will spread to other areas, thus, spreading the disease.